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JUNE 24, 1985

CHEMICAL & ENGINEERING

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ACHEMA 85
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Internationales Treffen für Chemische Technik und Biotechnologie

ACHEMA '85

West Germany's chemical technology show grows bigger
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CHEMICAL & ENGINEERING NEWS

Volume 63, Number 25
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JUNE 24, 1985

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■ **House votes to renew production of binary weapons if certain conditions are met.** Page 7

■ **Delays in divestiture deals, high interest payments cause steep drop in Reichhold stock price.** Page 7

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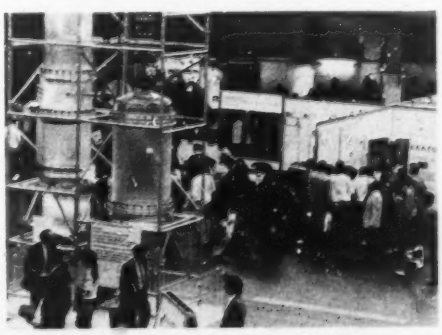

Cover Story

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LETTERS

CHEMICAL SAFETY

Perchlorates in doping polymers can pose hazards

The use of perchlorates in doping polymers is an example of the use of a hazardous material in an unusual manner. In a letter dated March 29, 1985, to the editor of C&EN, R. L. Elsenbaumer and G. G. Miller, Allied Corp., describe an incident which may serve to warn others who are using this type of procedure.

SIR: Recently a piece of perchlorate-doped polyacetylene film spontaneously detonated inside of an argon-filled dry box. Fortunately there were no injuries to personnel or loss of equipment. Since highly conductive perchlorate-doped polyacetylene is studied by a substantial number of people around the world, we wish to emphasize the potential hazards of handling this material. The details of the incident follow:

Perchlorate-doped polyacetylene was prepared by a slight modification of the method of Reynolds et al. [*J. Chem. Soc. Chem. Commun.*, 1358, 1982]. A piece of polyacetylene film was placed in contact with a solution of ferric perchlorate in toluene/nitromethane for 72 hours at room temperature. After washing and drying under high vacuum, the film was taken into an argon-filled dry box. A piece was cut from the sample and the remainder was stored under argon in a sealed vessel. Two weeks later, additional samples were needed, so the vessel was re-evacuated and taken back into the dry box. The vessel was refilled with argon and, as the top was being removed, the contents detonated.

We know of no reported incidents with this material, except Yang and Chien [*J. Polymer Sci., Poly. Chem. Ed.*, **23**, 859 (1985)], in which they describe the thermal instability of perchlorate-doped polyacetylene. In TGA runs under nitrogen, samples of $HClO_4$, $Fe(ClO_4)3$ and electrochemically $LiClO_4$ doped polyacetylenes exploded at 130, 160, and 180 °C, respectively.

Before working with it in our laboratory, we prepared small quantities to determine the propensity to detonate. Hitting samples with a hammer, bending, cutting, tearing, or even putting them directly into an open flame did not provide any indication of instability. But, as is the case with anything containing the perchlorate anion, there is always the danger of a spontaneous detonation. Unless appropriate safety precautions can be taken, we strongly urge that the perchlorate ion be avoided as a dopant for conducting polymers.

The possible influence which the nitromethane may have on the stability of the perchlorate-doped material is not known, but no incidents have been reported in which this solvent has been a negative factor in the safe handling of this or any other doped polymer.

Ronald L. Elsenbaumer
Granville G. Miller
Allied Corp.
Morristown, N.J.

Bredig's earlier observation

SIR: C&EN reports (May 27, page 54) that the first oscillating catalysis observed was iodate-iodine decomposition of hydrogen peroxide (Bray, 1921). A clearly earlier observation was the pulsing decomposition of H_2O_2 on metallic mercury, reported by Bredig in *Z. physik. Chem.*, **42**, 601 (1903). Iron and copper also have been reported to produce this effect with H_2O_2, but the cyclic reaction on mercury is easily demonstrated (keep pH above 8 in modest H_2O_2 concentrations).

Ralph L. Wentworth, *Cambridge, Mass.*

Shared research credit

SIR: I would like to correct an error and omission in the article concerning solid ionic conductors by Shriver and Farrington that appeared in the May 20 issue of C&EN, page 42.

The early work at Ford Motor Co. on β-alumina included not only myself and Joseph T. Kummer (not James T. Kummer as given in the article), but also Neill Weber now at Ceramatec Inc., Salt Lake City. The research effort at Ford on the sodium/sulfur battery was based on the elegant work of Weber, which lead to, among other things, the discovery of Li and MgO stabilized β''-alumina. For example, see the paper on the Na/S battery (670179) presented by Weber at the Society for Automotive Engineers, January 1967.

Yung-Fang Yu Yao, *Dearborn, Mich.*

Corrections

- May 27, page 56: Silicon nitride ceramic materials are conventionally made by processes that do not involve either liquid intermediates or meltable or organic-soluble solids. In the process developed by chemists at MIT, hydrogen gas eliminated during the polymerization process arises from the release of hydrogen atoms located on adjacent silicon and nitrogen atoms, not silicon and carbon atoms.
- June 10, page 44: The financial data reported for Lubrizol Corp. have been transposed with those for Loctite Corp.

Mineral-Based Inorganics Face Slower Production Growth

Stagnating demand for lime, sulfur, potash, and phosphorus will hold output below highs set in late 1970s and early 1980s for years to come

Bruce F. Greek, C&EN Houston

Demand this year for the large-volume, mineral-based inorganics isn't expected to change much from last year. Growth has declined to minimal levels for three of these chemicals—lime, sulfur, and phosphorus. And the fourth—potash—will coast or possibly decelerate slightly. As demand levels off, a number of situations likely will result, including little growth in production, plant capacity, and capacity use, and pressure on selling prices.

Production of these mineral-based inorganics remains well below recent historical highs set either in the late 1970s or early 1980s. With little growth expected in demand this year, and possibly even less next year and during the rest of the eighties, new records for production seem unlikely to be set anytime soon.

Behind these less-than-spectacular expectations for production and demand are lackluster forecasts for the major uses of these inorganics. Two of them—sulfur and potash—with more than 42% of estimated 1985 tonnage for all four, depend on agriculture for a very large share of their consumption, and agriculture is an industry clearly in financial trouble. A large part of the demand (not quite half) for the other two inorganics also goes to uses with little or no growth forecast for the next several years.

Key Chemicals

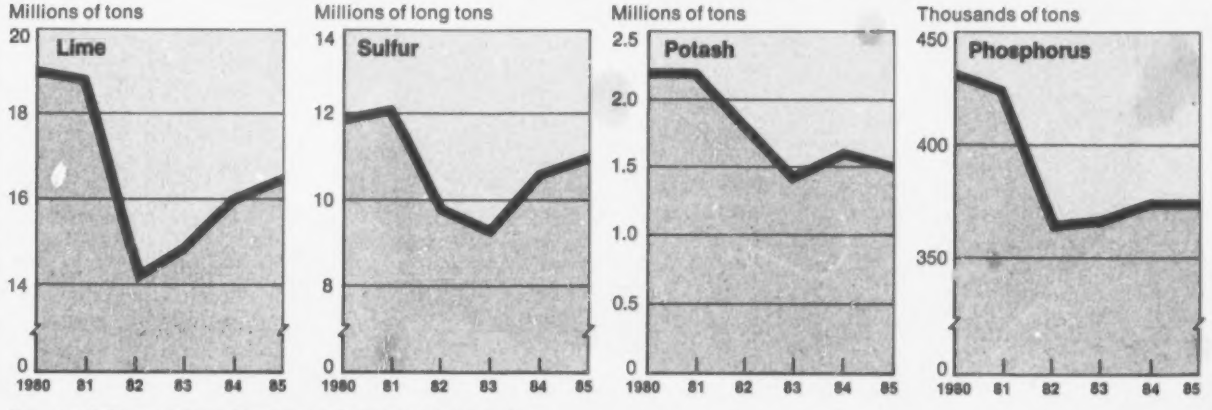
Producers of these inorganics naturally hope to gain new markets for their products, either directly or as derivatives. Unfortunately, these inorganics have had large production declines with just partial recovery for four years, during which time pressure on selling prices has been severe, and returns on investment have been reduced to minimal levels. Such a situation provides little money for research and development investment.

As a result, new products, derivatives, and uses of these inorganics are few. No major new use looms now for any of these chemicals, with the possible exception of lime—which has the properties needed for many kinds of air, water, and solid waste pollution control.

Unless something unexpected occurs to change demand for these mineral inorganics, growth in production through the end of the 1980s will range in the 1- to 2%-per-year average. And phosphorus, because of a decline in its large hold on household detergents, may suffer a 1 to 2% annual decrease in production over this period.

For details of the near-term outlook for these mineral inorganics, please see the following pages.

Production of mineral inorganics recovers but remains below 1980 levels



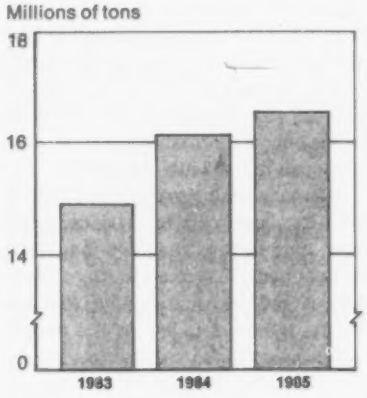
Sources: U.S. Bureau of Mines, Department of Commerce, C&EN estimates

CaO

Lime

- ***Demand growth slower***
- ***Capacity in excess***
- ***Prices weak but holding***

PRODUCTION



Note: No capacity estimates are available.

MAJOR PRODUCERS

Chemical Lime, Dravo Lime, Genstar, Marblehead Lime, National Lime, U.S. Gypsum

HOW MADE

Calcining limestone to make quicklime, CaO-MgO, then adding water to make hydrated lime

MAJOR END USES (U.S.)

Metallurgy (mainly steel) 40%, pollution control and wastewater treatment 15%, chemicals 10%, potable water treatment 10%

FOREIGN TRADE

Exports—tiny and holding at about 20,000 tons, imports—small and declining to about 200,000 tons

PRICES

$50 to $55 per ton, list, with variations for volume, type, and plant location

Lime producers have reason to expect an increase in their total output in 1985 to about 16.5 million tons. At that level, production will not be near the recent historical high of some 21 million tons in 1979, but it will be substantially above the recession low of about 14 million tons in 1982.

This year's production of lime—one of the oldest chemicals known to man—will be up about 400,000 tons, or about 2%, from production in 1984. That incremental gain will be much smaller than last year's, resulting from the continuing shift in uses of lime. Major long-term uses in the metallurgical field are expected to decline again in 1985, but this drop will be more than offset by increased use in construction and in pollution control. Both of these lime uses also will continue to grow relatively fast, giving hope to producers who recently have had severe problems from excess production capacity.

No estimate of total plant capacity is available for lime production because of the diversity of producers and because of the relative ease with which plants can be shut down and restarted. Some plants have been down for several years now, because of declines in metallurgical demand by steelmakers during the 1980s. The Bureau of Mines reports that 137 plants produced lime during all or part of 1984, down from 154 plants in the 1979 peak. The average operating rate of these plants in 1984 was well below that in 1979.

The lower lime-plant operating rate results in part from the problems in demand for steel. About 20% of lime production is captively used, with a big share of the captive lime used as a fluxing agent in steelmaking. During 1985, steel mill operating rates have slipped after rising last year, leading to lower estimates for that use of lime.

Besides steelmaking, the other big metallurgical use of lime is in processing copper ores, bauxite, and other nonferrous metal ores. Copper production, in particular, has declined rapidly, which has hurt overall demand for lime.

The fastest growing uses for lime are in the environmental area. About 10% of total lime use goes to treat water in preparation for potable uses and another 15% of the total is used for various kinds of pollution control. The latter includes sewage treatment, acid mine water drainage neutralization, and sulfurous gases removal.

Stack gas scrubbing, however, keeps growing quite rapidly and will require some 1.25 million tons of lime this year. The future for this use of lime could be very bright, if addition of scrubbers measurably alleviates acid rain by reducing sulfur gas emissions from power plants and other plant stacks. Addition of wet or dry scrubbers to existing power plants could be expensive and operating costs high, so efforts are under way to develop burners through which hydrated lime is injected in preference to limestone. This is because lime's relatively greater surface area improves reactivity.

Still other new and large potential uses for lime in pollution cleanup could result from tests under way in Ohio to use lime to neutralize and coagulate waste pickle liquors containing oils now lying in pits. The dewatered product would go to a landfill.

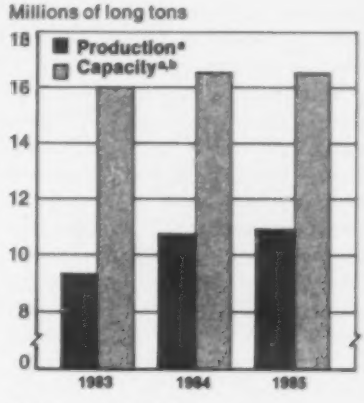
The other major uses of lime will contribute to demand growth this year as they offset declines in the metallurgical use, but none will show very rapid growth. Chemical manufacturing has become a very diverse use with the various individual uses varying from year to year. A sizable decline in one area of this use will occur this year, when the last synthetic soda ash plant is closed down. Pulp and paper manufacture takes about 1 million tons a year of lime as makeup, in addition to large quantities recycled. Construction uses of lime could be up because of more soil stabilization for road building, and increased use as an antistripping agent in asphalts.

S

Sulfur

- ***Production holding***
- ***Capacity level steady***
- ***Prices may rise***

PRODUCTION/CAPACITY



a All sources. b First quarter.

MAJOR PRODUCERS

Exxon, Freeport Minerals, Pennzoil Sulphur, Shell Oil, Texasgulf

HOW MADE

Melted from underground deposits; recovered from sulfur compounds processed in refineries, natural gas processing plants, and smelters

MAJOR DERIVATIVES (U.S.)

Sulfuric acid 90%, chemicals 5%

MAJOR END USES (U.S.)

Fertilizer 60%, chemicals 20%, metals recovery and processing 5%, petroleum refining 5%

FOREIGN TRADE

Exports—may decline to 1.2 million long tons, imports—may hold at 2.5 million long tons

PRICES

$147.50 per long ton at Tampa, after discount

Sulfur production gains have about run their course for 1985. A good spring fertilizer season pushed production of sulfuric acid, but for the entire year production of sulfur will do well to increase marginally over 1984 to about 10.9 million long tons. Prices for sulfur continued to increase early in 1985 after a good boost in 1984, suggesting a possible tightening of supplies. But now, economics of demand for major sulfur-containing products—fertilizers and other chemicals—seem to be more important in sulfur pricing than does supply.

There are major reasons why sulfur output has shifted from good growth to almost no gain. This year, because of predicted lower exports of fertilizers, production of phosphoric acid used mainly in the making of fertilizers is forecast to decline. A lower phosphoric acid production would reduce the need for sulfur some 200,000 to 300,000 long tons. Exports of sulfur also are likely to decline 5 to 10%, or possibly as much as 100,000 long tons. The reduction in aboveground inventories of Frasch sulfur will continue, although probably at a somewhat slower rate than in the past two years.

An involuntary decline also will occur in recovered sulfur production in 1985. Refinery and gas-processing operations have been restricted during the first half of this year because of slack demand and because of imports of fuel products. That situation, in January, for instance, caused Frasch sulfur production to exceed recovered sulfur output for the first time in more than two years.

Increased use of sulfur in the nonfertilizer manufacturing area, such as chemicals manufacture, will offset the expected decline in demand for making fertilizers. And imports of sulfur also might decline slightly, perhaps about 100,000 long tons, thereby reducing the potential supply. Lowered imports would have to be made up by increased domestic production.

Meantime, sulfur capacity has gone on hold. Additions to capacity to recover sulfur from crude oils and natural gas are being offset by shutdowns of similar capacity, as refining declines and some gas fields are depleted.

Capacity utilization in sulfur production means little because capacity to recover sulfur from hydrocarbon streams is purposely overbuilt to ensure that the sulfur is removed to prevent air pollution. Estimates of capacity to produce sulfur by the Frasch process also are approximate, because sulfur-bearing formations vary in their response to hot water injection.

Capacity estimates of 16.5 million long tons per year to produce sulfur from the various sources could be understated, if the sources are more fully utilized. Full utilization would mean full operations at refineries and at gas-processing plants, maximum (despite the economics) injection of water at Frasch operations, and full operation of the various kinds of smelters. Small additional quantities could be obtained from pyrites, miscellaneous ores containing sulfur, and industrial production of various sulfur-containing gases.

Concern about a shortage looming soon for sulfur may be unwarranted. Relatively large stocks of sulfur are above ground in vats in both the U.S. and in Canada. For economic reasons, these stocks can be reduced to meet demand without an increase in production.

However, longer term, the currently producing Frasch sulfur deposits will become depleted, and major Frasch producers have extensive exploration programs under way for economically suitable new deposits. As part of the continuing search for petroleum supplies, additional sour gas is becoming available as a source for sulfur.

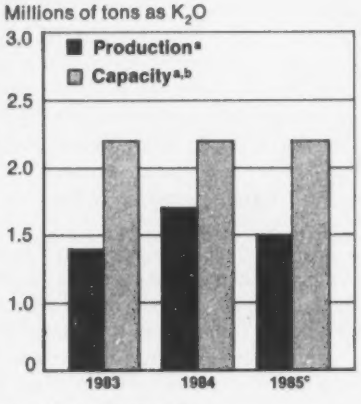
For all of 1985, demand for products using sulfur or made from sulfur may remain about even with last year's. Total demand, however, will remain strong and will keep sulfur prices relatively high.

KCl, K_2SO_4, $K_2SO_4 \cdot 2MgSO_4$

Potash

- ***Production to decline***
- ***Capacity partly closed***
- ***Prices weak***

PRODUCTION/CAPACITY



a All forms. b First quarter.
c More than 25% capacity shut down.

MAJOR PRODUCERS

AMAX, IMC, Mississippi Chemical, New Mexico Potash, Potash Corp. of America, Texasgulf

HOW MADE

Shaft and solution mining of potassium salts, mainly the chloride, and subsequent purification; recovery by evaporation of brines

MAJOR END USES (U.S.)

Fertilizer 95%

FOREIGN TRADE

Exports—may decline to about 500,000 tons, imports—holding at about 5 million tons

PRICES

About $100 per ton, list, depending on type and salt

The U.S. potash industry seems to be set for some changes. Production this year may drop more than 10% from last year, and operating capacity likely will decline a like amount. In addition, some of the mines in New Mexico have changed ownership, and more changes are rumored to be in the works.

Potash production this year likely will be about 1.5 million tons, reported as K_2O. However, variables such as weather, farm economics, the size of inventories, and prospects for next year can add to or subtract from this estimate. The best or the worst conditions would increase or decrease production about 200,000 tons.

U.S. production of potash falls far short of consumption, with the difference made up by imports from Canada. In 1984, about 6.1 million tons of potash were consumed, 95% of which was used as fertilizer. The other 5% was consumed in making a wide variety of chemicals that require the potassium atom. Most of this, some 5 million tons in 1984 with the same amount forecast for 1985, is Canadian imports, which have been coming to U.S. markets for a long time. In 1980, imports of just less than 5 million tons accounted for 78% of the slightly higher consumption of 6.35 million tons. Imports slipped by more than 1 million tons in 1982, to 3.9 million tons, as total consumption dropped 1.2 million tons. Imports, as well as total consumption, climbed back to historical levels as the payment-in-kind program was completed in 1984.

Logistics play a part in what may seem to be a large volume of imports in relation to consumption. U.S. exports this year are estimated to be some 500,000 tons of potash, a volume that could have been used in place of part of the imports. However, the vast majority of U.S. potash production is in eastern New Mexico, far from areas of high consumption, but relatively closer to ports that can service sales to South America and other areas at lower cost than can potash produced in Canada.

Because of the strong U.S. dollar compared to Canadian currency, Canadian production—some by U.S. companies operating in Canada—and Canadian exports to the U.S. cost less than U.S. product. Transportation distances also aid sales from Canada.

The poor economics of potash production in New Mexico have existed for years, with mines and mills there being shut down from time to time. The most recent was Kerr-McGee's decision to shut down and sell its New Mexico operations. At one time, Kerr-McGee had 600,000 tons of potash capacity there. The company took a $24 million write-off on these operations and sold them to New Mexico Potash in April of this year.

New Mexico Potash, a wholly owned subsidiary of Vertac Chemical of Memphis, announced that it would operate one of the two processing facilities it acquired with a capacity of 300,000 tons per year. Part of the production is used captively by Vertac at its plant at Vicksburg, Miss., where it makes potassium nitrate.

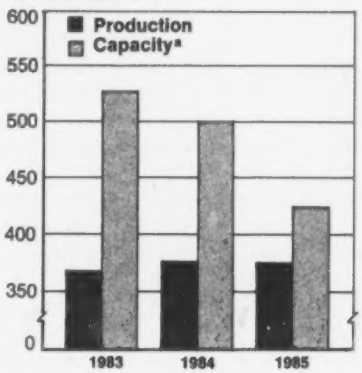
Although not all results are in yet for fertilizer demand for this spring season, early indications are that the large inventory of potash built up during the second and third quarters of 1984 have been drawn down. However, this inventory drawdown so far hasn't helped the depressed prices for potash very much, if any, according to one industry source. Producers may try to keep inventories down by holding down production this summer until they can determine the size of crops produced this year, farm commodity prices, and prospects for fall fertilization and 1986 spring consumption, the source adds. If prospects seem to be good, then potash production may be increased some in the fourth quarter, making the early forecast of a production of 1.5 million tons a bit low. A somewhat higher production, however, probably won't do much for prices.

P_4

Phosphorus

- **Production flat**
- **Capacity reduced**
- **Prices holding**

PRODUCTION/CAPACITY



[a] First quarter.

MAJOR PRODUCERS

FMC, Monsanto, Occidental, Stauffer

HOW MADE

Reduction of phosphate rock in electric furnaces with carbon (coke) and silica as aids

MAJOR DERIVATIVES (U.S.)

Phosphoric acid and derivatives 85%, other chemicals 10%

MAJOR END USES (U.S.)

Detergents and cleansers 45%, metal treatment 15%, foods and beverages 10%, chemicals 10%

FOREIGN TRADE

Exports—expected to hold at about 20,000 tons, imports—negligible

PRICES

91 cents per lb, list

Phosphorus producers this year will have the best capacity utilization rate among the major-volume mineral inorganics. Although actual production will be up marginally, if at all, from last year, use rates will be up because electric furnace phosphorus capacity has dropped 20% in the past two years.

A good plant operating rate, however, doesn't mean that all is well with the phosphorus industry. The reduction in capacity during the 1980s clearly indicates that this industry has had and continues to have problems. The production estimates for 1984 and 1985, at 375,000 tons, are up less than 5% over the recent historical low of 361,000 tons in 1982.

However, production this year may not even reach 375,000 tons, depending on demand by the major uses such as detergents and cleansers, metal treating, and foods and beverages. Estimates of reported output by the Department of Commerce for the first quarter total just over 100,000 tons, but this production may be high for seasonal reasons.

The chance that phosphorus production will return to 1980's level or higher soon seems slim. The 1980 production total of more than 430,000 tons exceeds some current estimates of nameplate capacity. Thus, new plants would be needed to produce even 400,000 tons. Equally slim is the likelihood that new plants will be built at today's production economics. Low selling prices of elemental phosphorus and the derivatives made from the acid from this phosphorus will not allow construction.

Manufacture of detergents and cleansers dominates the electric furnace phosphorus uses at about 45% of domestic consumption. Most of the thermal phosphoric acid used in detergents and cleansers is made into sodium tripolyphosphate (STPP). This use of thermal phosphoric acid in the U.S. differs from the situation in most other countries where wet-process phosphoric acid is used in making STPP. Small amounts of wet-process acid, however, are used in STPP in this country.

The problem for producers of phosphorus and of STPP is the expanding regional bans on use of phosphate builders in detergents. The bans aim at reducing water pollution. For example, a prohibition on detergent phosphates has been passed in Maryland and one might be passed in the next legislature in North Carolina. Removal of a ban on phosphate in Dade County, Florida, has helped in a small way, but not enough. Some Great Lakes states have banned sale of phosphate-containing detergents, and others are expected to do likewise.

STPP and other phosphoric acid derivatives also go into a variety of household, industrial, and institutional cleansers, many of which are formulated for specific uses. Their consumption changes as they move in and out of favor with new formulations and new advertising campaigns. Growth of these products continues to be small and will have no significant effect on demand for phosphorus this year.

Metal treating ranks next in volume to detergents as a consumer of phosphorus, but it is a distant second accounting for about 15% of total consumption. Use in metal treating—most of which is in the automobile industry—will have little, if any, effect on changes in consumption of phosphorus this year. Down-sizing of cars and a shift in style away from bright metal trim indicate that this use likely will not grow much this year and will leave demand substantially lower than at the beginning of the decade.

Food and beverage uses of thermal phosphoric acid grow at about the same rate as population growth. Shifts in fashion and diets change the pattern of individual products' consumption of phosphoric acid and derivatives, but the net growth remains small and is not enough to do much more than offset a minimal part of the declines in other uses.

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Scientific Freedom

Universities' concerns about national security controls ease

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Cover: Photo by Stacy Pick/Uniphoto

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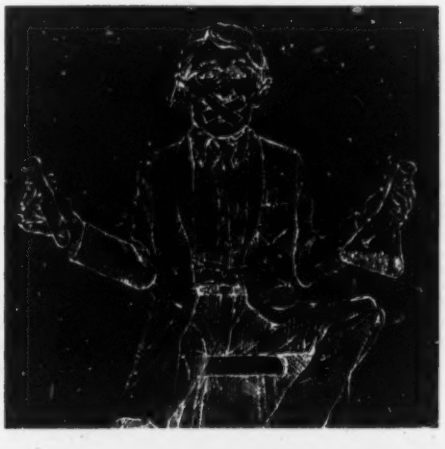


News Focus

Academic researchers no longer are threatened by government control of information exchange, but purveyors of technology with both military and commercial applications are being restricted. **Page 7**

Chemical Industry's Health Care Benefits Likely To Change Further

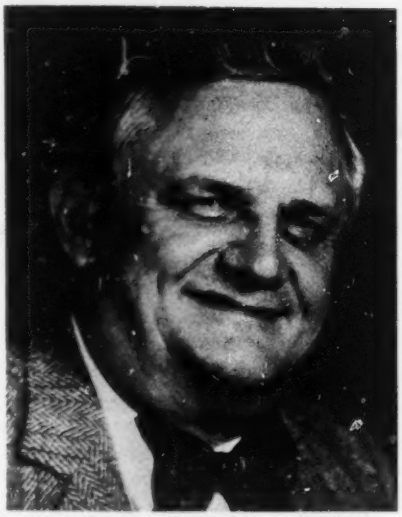
Firms' medical expenses are rising more slowly now, but increase in cost-containment measures is foreseen; new retirees face changes, too

David Webber, C&EN New York

With some carrots and many sticks, chemical companies have induced employees over the past few years to accept changes in their health care benefit packages that would have been unthinkable to many of them five years ago.

Citing the need to slow the rate of medical care inflation, much of the industry has eliminated traditional benefits like coverage for hospital stays from the first dollar on and has given employees financial incentives to use less-expensive alternatives to in-hospital treatment. Since doing so, most firms say, they have experienced smaller annual increases in their health care benefit expenses.

But, companies say, as welcome as these results are, the measures adopted so far may not be enough. Although firms have benefited from the shifting of a portion of their expenses to employees through deductibles and other cost-sharing devices, medical care costs in the U.S. are still rising at double the rate of the consumer price index. Furthermore, how much of the slowdown in the growth of corporate medical benefit bills is due to the cost-containment measures instituted so far and how much to the past four years' deceleration of overall inflation is open to question. For that reason, many companies seem to be contemplating further changes in their health care benefits programs,



Wetzel: second opinion provisions

all designed to mold employees into what has sometimes been called "better health care consumers."

Judging from the plans of 10 major chemical producers surveyed for this report, companies have completed—or at least set in motion—the bulk of whatever shifting of costs from themselves to employees they wish to accomplish. The argument for cost sharing is that employees and their dependents will select health care services more carefully if part of the fee comes out of their pockets. That logic has proved itself essentially correct. Now many companies intend to focus on producing subtler changes in their employees' health care utilization patterns. The goal will be greater use of such alternative forms of health care delivery as outpatient surgery, home care, birthing centers, and the like. The means will be a greater emphasis on such carrot-and-stick combinations as second opinions for certain surgical procedures and precertification—by benefit plan administrators or company medical departments, or both—of the need for a hospital stay.

Action began to be taken by both the government and many industries in the early 1980s in an effort to get health care costs under control (C&EN, June 27, 1983, page 6). The government's medicare and medicaid costs were ballooning wildly, and industry's health care benefit expenses were making up an increasingly noticeable percentage of net income. Americans were using medical services more each year, a trend that was seen leading doctors and hospitals to run bills up with superfluous procedures and protracted hospital stays. The portion of the gross national product made up of hospital bills alone had risen to nearly 4%.

Today there is broad evidence that the efforts made by both companies and the government to check medical care inflation have paid off. In 1984, the number of hospital admissions dropped 4% from the year before. Hospital occupancy rates fell 8%, and the average length of stay declined 4%. Hospitals' share of GNP has moved down to 3.4%. The annual increase in medical care costs, according to the Labor Department, has slowed from 12% in 1982 to 9% in 1983 to 6% in 1984. Over the first three months of 1985, the index was up just 4% over the 1984 average.

Most chemical companies have benefited from this reversal of the long-term trend. Dow Chemical, for example, made a major change in its employee health care benefits plan last October, leaving employees the choice of retaining the old first-dollar coverage, albeit with steadily rising employee premiums, or enrolling in a new comprehensive plan in which employees share costs but pay a much lower premium. The pattern of Dow's annual

medical benefit expense increases suggests that the new plan is working: After year-to-year growth of 15% in 1980, 9% in 1981, 14% in 1982, and 12.5% in 1983, Dow's health care benefit expense rose just 6% last year. The company expects a similar increase in 1985.

Because general inflation was slowing during the same period, it is difficult to determine how much of the credit for decelerating corporate health care expense growth belongs to plan changes, but examples from other firms that have changed their plans offer evidence that cost sharing and other new plan features have had an impact. At Air Products, which changed its plan last October, the corporate medical bill grew at a 17% annual compound rate between fiscal 1979 and 1984, says Raymond A. Glennon, manager of employee benefits. In fiscal 1985 (ending Oct. 31), he expects an increase of just 5 to 6%.

Ethyl, after implementing cost-containment measures in January 1982, watched growth of its health care bill drop to 16% in 1983, 12% in 1984, and, if estimates are correct, the company's expense will actually decline this year nearly 9%. Hercules was paid back for its July 1983 benefit revision with a net decrease in its medical care bill of somewhat less than 2% in 1984, according to Fred Laquinta, manager of benefits planning. And at Rohm & Haas, the optional cost-sharing benefit package has been so cost effective since its inception in 1983 that, beginning this year, the company stopped charging employees in the new program any health insurance premium.

The experience of Monsanto offers some comparison. Although the company has implemented incentives—some voluntary and some not—for employees to use cheaper alternatives to hospitals, there has been no addition to cost sharing. Between 1980 and 1985 (estimated), the company's medical benefits bill will grow at a compound rate of 12% per year, says Elizabeth J. Hawk, manager of compensation and benefits.

"The increases have slowed somewhat in recent years, but primarily because general inflation slowed and

Health care cost-containment measures have slowed the rate of increase of hospital costs

Fostered chiefly by fixed medicare fees but furthered by corporate changes in health care benefits for employees, the rate of increase of hospital costs in the U.S. has slowed considerably since 1983. Hospital costs rose just 4.5% in 1984, the smallest annual increase since 1963 and well below the 10% rise recorded in 1983, according to the American Hospital Association. For the first time in more than two decades, hospitals' portion of the gross national product declined—to 3.4% last year from 3.6% in 1983.

Several changes in long-term trends brought about the hard braking of hospital cost growth. Most significant, fewer people checked into hospitals. After peaking at about 38 million patients in 1982, admissions dropped in both 1983 and 1984, decreasing about 1.5 million in 1984 alone. As a result, the hospital occupancy rate fell to 67% in 1984, and the average length of time patients stayed in hospitals declined to 6.7 days, the first time the average stay has been below seven days in more than a decade.

At the same time, the number of outpatient visits to hospitals grew a modest 1.1% to more than 232 million in 1984. That development reflects both the need for hospitals to keep costs within fixed reimbursement limits for medicare and medicaid patients, and the combination of financial incentive and persuasion with which corporations have prodded employees into using outpatient services over hospital admission whenever possible.

In fact, ambulatory surgery, one of the chief elements of outpatient health care, ranked first among corporations as a strategy to control health care costs last year, according to an AHA-sponsored survey of 200 of the nation's largest industrial firms. Among the other most important strategies cited in the survey were other alternatives to in-hospital procedures such as preadmission testing (to shorten the length of a hospital stay); utilization review programs (to check hospital and doctor bills); second-opinion programs; home care; and preadmission review (to determine the necessity of admission). The companies also said they had saved significantly through greater cost sharing with employees and self-insurance programs.

More specifically, more than a third of the firms require employees to get a second opinion before elective surgery, and most of those assess a penalty if an employee fails to do so. A third of the firms negotiated contracts with unions last year, resulting in additions to health care benefits 36% of the time compared to reductions in benefits just 19% of the time. Nevertheless, coinsurance amounts (the percentage of medical charges an employee pays after exhausting his or her deductible) were increased in 41% of the new contracts. The survey also found that 80% of the companies surveyed are now self-insured.

Despite the slowing down of health care inflation by the above measures, however, medical care costs continue to outpace the consumer price index. In 1984, for instance, the medical care price index (supplied by the Department of Labor) rose 6%, down nicely from a 9% increase in 1983 and a 12% increase in 1982. But those rates were still far higher than those for the consumer price index, which rose 3% in 1984, 3% in 1983, and 6% in 1982. That is why some chemical companies, though pleased with the progress made so far, believe further steps will have to be taken to keep health care costs under control.

	Hospital admissions	Occupancy rate	Average stay (days)	Outpatient visits
1984	36,198,537	66.6%	6.7	232,190,313
1983	37,691,924	72.2%	7.0	229,557,530
% change	−4.0%	−7.8%	−4.3%	1.1%

Note: Figures are for all U.S. community hospitals (excludes specialty and single-service hospitals); figures adjusted for leap year 1984. Source: American Hospital Association

because of the fledgling competition in the health care marketplace," she says. "The fact is that the trend is still way too high and is expected to return to double-digit levels."

Whichever change—in inflation or in benefits provisions—most accounts for the slower growth of corporate medical benefit expenses, most benefits managers believe further steps will have to be taken. "There are still things we haven't done," remarks Edward A. Howes, manager of employee benefits planning at PPG Industries. As medical costs continue to rise, for instance, the company might raise employee premiums, deductibles, and coinsurance (the percentage of fees paid by the employee after the deductible is exhausted).

"Yes, there will undoubtedly be more changes," says Hercules' Laquinta. "We are seeing the creep of health care inflation again. In a year or so, we will take the next step." New provisions might include precertification for nonemergency hospitalization, concurrent reviews of hospital stays, and "large-case management," in which a team of doctors, hospital administrators, and other experts would be convened to weigh the options for employees needing expensive treatment. "That's inevitable," he says of the last item.

Monsanto, says benefits manager Hawk, is looking at other ways to stem the double-digit annual increases still being absorbed there. "There is no firm plan yet," she says, "but we know we can't continue to accept this trend." Similarly, Dow Chemical is considering various possibilities, although nothing further is planned now.

To a certain extent, chemical companies have entered a phase in which they are fine-tuning their employee health care benefits plans. They are not absolutely certain yet which aspects of the new programs are most cost effective—both because of the clouding effect of the downward trend of inflation and because, at many companies, large numbers of employees are still gradually shifting from traditional coverage to the new plans. Still, many benefits departments have a far better idea now of where their health care dollars are going than they did at the beginning of the decade.

The chief reason is a widespread upgrading of computerized analytical systems for benefits administrators. For example, Du Pont's manager of benefits and health care William C. Deans admits that the company previously had no comprehensive data system with which to track its medical spending. Now, he says, the company analyzes its expenses on a quarterly basis.

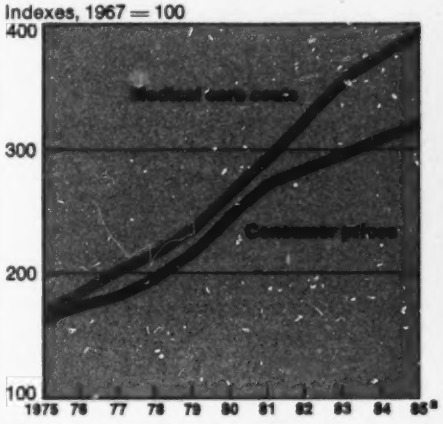
"Now we can begin to understand what we're paying for," he says. The company structures some of its analysis according to the diagnosis-related groups formulated by the government to control reimbursement for medicare. In this way, Du Pont is able to quantify the percentage of its medical spending that goes for hospital room charges, for pharmaceuticals, for testing, and for other major categories.

Better data analysis can enable administrators to refine their plans in the future, companies say. Air Products, for instance, has placed a much greater emphasis on gathering data on the utilization of its benefits since changing plans last October. "It is now one of the most important parts of the operation," comments Raymond Glennon, "answering the question: Where are the dollars being spent? I would like to be in a position to identify the cost-effective health care providers, and then, through plan design, use the plan to get employees to use them."

At the least, companies are finding, enhanced data analysis can serve to justify the changes already made. Hercules' Laquinta points out that computer modeling comparing the company's revamped medical benefits program to its former one showed that Hercules would have spent 17% more in 1984 than in 1983 under the old system.

With this greater ability to locate the leaks in their benefits programs, companies now plan to make greater use of second opinions for nonemergency surgery and precertification to steer employees into greater utilization of outpatient health care. Many chemical company benefit plans already include voluntary versions of a second opinion feature; some have made them mandatory.

Medical care costs still rising faster than overall inflation



a First quarter. Source: Labor Department

Since the first quarter of this year, Monsanto has been requiring a second opinion before approving coverage for a group of 14 surgical procedures. Dow has been doing the same since last October, both for those employees who have signed up for its new cost-sharing plan and for those who have remained in the old first-dollar plan. Rohm & Haas' employee benefits department, which already has inserted mandatory second opinion provisions in some union contracts, plans to recommend the same requirement to senior management for all salaried personnel, says corporate supervisor of employee benefits Ron Wetzel.

Potentially more controversial is mandatory precertification processing. In general, such a provision would require an employee whose hospital admission for a nonemergency procedure had been ordered by a physician to submit his or her case in advance for review. In most cases, a first screening by a registered nurse would be enough for approval, companies say, but if the nurse questioned the need for the operation, the case would be passed on to a physician or some other higher-ranking review board.

Companies have been reluctant to institute precertification because, unlike cost-sharing devices, it is seen in some camps as an intrusion by the employer into the physician-patient relationship. As Rohm & Haas' Wetzel remarks, there is a cer-

tain "Big Brother" aspect to such a provision.

Still, many benefits administrators believe precertification is a necessary next step in controlling medical spending. "We are coming to the conclusion that it would help employees contain costs," says PPG's Howes. "And they do have to be mandatory. There are not enough savings when they are voluntary."

Air Products has approached precertification in a gingerly fashion, setting up an on-site nurse/coordinator at its Allentown, Pa., headquarters with a combination precertification/consumer awareness counseling function. For most admissions, says benefits manager Glennon, precertification is not necessary. It is required if an employee is applying for such newer benefits as hospice, drug or alcohol abuse center, or home health care.

The real value of precertification programs—especially if combined with utilization review (examination while a patient is in the hospital of the procedures ordered and the length of stay)—may not lie so much in individual cases, comments Rohm & Haas' Wetzel. Instead, it may lie in cultivating an environment in which physicians know that their decisions will be subject to peer review.

As companies enlarge their role in reviewing the need for employees to undergo certain medical procedures, they also may face difficult decisions about which types of very expensive operations they will cover. Many firms already exclude many nonemergency "cosmetic" procedures, such as radial keratotomy (surgery to correct near- or farsightedness). But determining which procedures to cover in "life-and-death" situations may become more troublesome as advances in medical technology make possible operations, such as liver transplants, that may costs hundreds of thousands of dollars. The number of organ transplant operations especially is expected to increase as organ donor programs are refined. Because many such operations are considered experimental now but, because of swift medical advances, may become recognized as standard procedure by the medical community within a relatively short time, there is a gray area in which some fine distinctions must be made. In some cases, the gray area is made even grayer by disagreement on which procedures should be considered experimental. There is no single body that decides; generally, it is up to the insurance carrier.

To deal with the possibility of tremendously expensive claims, some companies have instituted lifetime caps on coverage per participant in their medical benefits program. Air Products, for instance, has a $500,000 lifetime maximum. "It can make you look cheap," concedes benefits manager Glennon, "but we think that our health care dollars are best spent at the front end, on measures designed to keep employees out of the health care pipeline."

Because many experimental operations—such as liver or artificial heart transplants—are still quite rare, most chemical companies have not yet had to make such decisions. And for the most part, companies are distanced from the decision-making process, leaving the determination to their insurance carrier, or, if they are self-insured, to an outside plan administrator. In any case, companies stress that in tailoring their benefits plans, they do not intend to deny beneficiaries any medical care they truly need.

"We won't strand an employee," says Du Pont's Deans.

Still, the campaign for cost containment is bringing companies into other uncharted waters. Chief of these is medical benefits for retirees. "The rate of increase has come down for active employees," points out PPG's Howes, "but we can't put the same controls on our retiree population. These costs are going way up. That is where the real concern is now."

Company efforts to restrain retiree medical costs encounter two stumbling blocks. First, recent court decisions prevent firms from instituting cost-containment measures in coverage for former employees already retired when plans were changed. And second, it is commonly believed—though no hard evidence yet exists—that many doctors and hospitals are shifting unrecovered costs stemming from the government's medicare reimbursement ceilings to the beneficiaries of private insurance programs. Since retirees tend to be heavier health care consumers, this effect has its greatest impact on the retiree population's claims.

Under these conditions, companies have made little change in retiree medical benefits, for fear of being taken to court. In general, however, they have altered the benefit program for employees retiring after the date of the plan change. For those retirees, the new cost-containment measures will apply. □

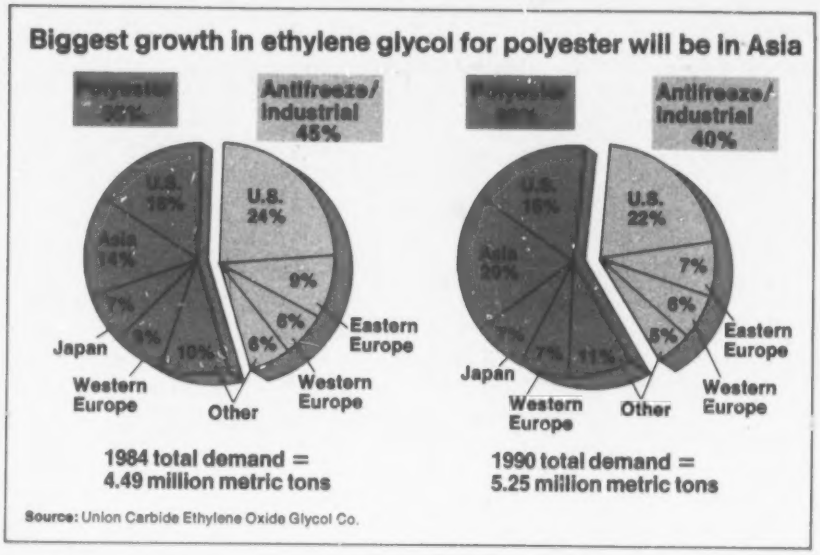
Global shakeout expected in ethylene glycol

"There is a war going on out there that only the fit will survive." That's how T. R. (Rick) Jones, vice president of Union Carbide Ethylene Oxide Glycol Co., describes the world ethylene glycol business today. Access to stable supplies of inexpensive feedstock, state-of-the-art technology, world-scale plants, and dedication to the business ultimately will determine who those survivors will be, he says.

The ethylene glycol market is truly a world market, and it is the key to the ethylene oxide-glycol business. The oxide itself is used very little as a product. Instead, most of it goes to downstream derivatives, with the glycols accounting for about 60% of the market. The remainder of the oxide goes into various other derivatives such as ethanolamines, glycol ethers, surfactants, functional fluids, and polyethylene glycols.

Glycol really has only three outlets—polyester, antifreeze, and a miscellaneous all-other category. Polyester is by far the largest market, consuming about 35% of all the ethylene oxide produced and about 55% of the glycol.

But that simplistic market breakdown belies an intense battle that is taking place for world market share. And it fails to reveal some important shifts in regional markets that Jones described at a recent



petrochemical meeting held by the Corpus Group in Calgary.

Behind the market battle is a worldwide overcapacity in both ethylene oxide and glycol. This year, for instance, world oxide capacity is about 7.3 million metric tons. Demand, says Jones, will barely hit 6 million metric tons.

Union Carbide, with six ethylene oxide plants in North America, musters 18% of the world's capacity. Other major producers include Shell, Dow Chemical, Imperial Chemical Industries, BASF, and the BP group, with 5 to 7% each. Japan accounts for 9% of world oxide capacity, and newcomer Saudi Arabia already has a 5% share.

Another group of producers, which Jones calls the "one per centers," consists of 34 different companies that control 37% of world oxide capacity. In the battle for survival, many of these small companies, along with a few of the larger ones, will be too weak to compete.

Most of this capacity rests in North America and Western Europe. But demand, Jones says, is shifting away from these two areas. The fastest growing region is Asia.

Last year, for instance, the U.S. accounted for 40% of world glycol consumption. Western Europe took 14%, and Asia accounted for another 14%.

By 1990, the picture will be much different. Jones estimates that the world glycol market will grow from last year's 4.5 million metric tons to 5.25 million metric tons. That's about a 3%-per-year average growth rate. During that time, polyester will increase its share of glycol consumption from 55% to 60%, whereas antifreeze and industrial uses will decline to 40%.

The big difference, however, will be the huge shift away from North America and Western Europe toward Asia. As the world glycol market is growing an average 3% annually—about equal to gross domestic product growth—demand in Asia will increase 8% annually, says Jones. Asia's share of the world demand for polyester glycol in 1990 will jump to 33%—greater than that of the U.S. and much higher than Western Europe's 12%.

The big question is how this shifting demand will be satisfied. Ethylene oxide supply will continue to outdistance demand at least through the early 1990s. And Jones defines supply as "maximum attainable production," not theoretical nameplate capacity. He does not think that supply and demand will start to come into balance before 1993 or 1994.

It's inevitable, then, that rationalization will have to occur in the industry, Jones says. "Weak producers cannot continue to operate or they will bleed to death," he adds. Over the next few years, then, he expects about 1 million metric tons of capacity to be shut down throughout the world. That's a lot of capacity—it represents three or four world-scale units. Jones believes that most of the plant closings will take place in Western Europe and in Japan. He bases his conclusion on a comparison of glycol economics there and in the U.S. (Gulf Coast), Canada (Alberta), and Saudi Arabia—all of which he calls resource-rich areas.

No one producing region has a dominant economic advantage over the others in every area of the world. But in Japan and Western Europe, all three resource-rich producers enjoy an economic edge even over local production. In those two areas, local producers' economics are poor because output is based on naphtha. That's why both Europe and Japan are logical candidates for plant closings. In Japan, the Ministry of International Trade & Industry (MITI) already has made plans to rationalize the ethylene oxide-glycol industry.

Thus, Jones believes that North America, which historically has been a net exporter, will continue to export. Western Europe, where supplies of ethylene oxide and glycol have been in excess, will have to rationalize over the next few years; it will become a substantial net importer of glycol by the late 1980s.

He also thinks that Latin America will become a net glycol importer and that Japan, after its plant scrapping exercise, will become a major glycol importer by the late 1980s. Asia has been an importer and will continue to be one.

By the end of this year, the Middle East and Africa will have become major exporters instead of importers. China, distinct from the rest of Asia, had a small net of glycol exports in the early 1980s but has become a net importer. If China builds its announced glycol unit, it will again become a slight net exporter to its Asian neighbors. Eastern Europe and the Soviet Union have and will continue to have an essentially balanced glycol situation.

The real glycol battle, says Jones, is not among the U.S., Alberta, and Saudi Arabia. It is between the resource-rich producers and the resource-poor producers. Eventually, he feels, the strong will prevail. But until then, industry profits will remain unacceptably low. □